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A Critical Analysis of Timber Supply Research Objectives for Regional and National Assessments

by

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INTRODUCTION

The RPA

The Forest and Rangeland Resources Planning Act of 1974 (RPA)[1/] has been widely hailed as landmark legislation in resource planning. It clearly lays out a structure for assessing the nation's renewable resources, preparing programs to guide their development and use, and using the assessments and programs as an integral part of the budgeting process of the U.S. Congress.

The RPA directs the U.S. Forest Service to lead the development of the assessment and programs, in cooperation with other public and private agencies. Accordingly, the Forest Service prepared a quick assessment and program in 1975, is now engaged in a more comprehensive effort to be released in 1980, and can look forward to preparing an assessment each ten years thereafter, and a program each five years thereafter. If all goes as intended, the programs will provide strong guidance to a Presidential Statement of Policy to be submitted to Congress, which in turn is intended to be used in framing budget requests for Forest Service activities over the ensuing five-year period.

As Manthy (1976) points out, much of what is required by the RPA is not new to the Forest Service. Earlier laws and administrative directives had guided the development of procedures similar to those required by the RPA. However, the RPA is much more explicit than

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[1/] P.L. 93-287 as amended by The National Forest Management Planning Act of 1976.

previous guidelines in requiring assessments to include "... an analysis of present and anticipated uses, demand for, supply of the renewable resurces, with consideration of the international resource situation, and an emphasis of pertinent supply and demand and price relationship trends." (Sec. 3 (a) (1), as amended by the National Forest Management Act of 1976.) Imbedded in the requirements of this paragraph are "methodological problems -- ones which may preoccupy researchers, analysts, professionals and policy makers for years to come." (Vaux, 1976.)

In Search of an Equilibrium

Nobody is more appropriate than Henry Vaux to point out the difficulties inherent in the analytical requirements of the RPA. Vaux and Zivnuska (1952) criticized the ceteris paribus timber "requirements" analyses of the U.S. Forest Service, which essentially ignored the costs of producing timber. They proposed instead a more complete model which would consider supply and demand schedules and lead to simultaneous solutions of quantity and price at the intersection of these schedules -- i.e. at equilibrium.

The Vaux and Zivnuska model, although standard classroom fare for graduate students in forest economics, has been slow to develop operationally. The advent of high-speed computers accelerated implementation of the model, but it took the RPA to provide the direction, and ultimately the resources, needed to work in earnest toward its development for use in national timber assessments. The 1980 RPA assessment will include comprehensive equilibrium analyses for timber,

including consideration of interregional and international trade (Adams and Haynes, 1978).

As significant as the modeling developments for the 1980 assessment might be, they will fall far short of the implied requirements of the RPA. The supply and demand analyses for timber will likely be much more sophisticated than for other resources. And even for timber, the linkages between demand and supply will be less than desired, primarily because timber supply analysis is bogged down by indeterminate forestland allocations among competing uses, questionable timber growth and yield information, the lack of information about how forestland owners intend to, or are likely to manage their lands, and inadequate models for assessing timber management alternatives.

Purpose of This Analysis

The purpose of this analysis is to take a critical look at timber supply research objectives in the context of the direction provided by the RPA. The analysis is aimed at providing guidelines for research to develop new approaches for doing timber supply analysis for post-1980 assessments. The specific objectives are:

1. To determine and investigate a fully array of objectives for timber supply research on regional and national assessments.
2. To assign relative research priorities to those objectives.
3. To develop preliminary suggestions on how top priority objectives should be pursued.

These objectives will be accomplished with a discussion of approaches for timber supply analysis, followed by a discussion of needs for research.

APPROACHES FOR TIMBER SUPPLY ANALYSIS

Approaches and Models

Many discussions of supply analysis get bogged down because of the failure to distinguish between an approach and a model. A simple distinction is that the model is a vehicle and the approach is how the vehicle is used.

The approach can be limited by the model. For example, one could formulate the model that harvest at time t + 1, (H_{t+1}) is a function of harvest at time t, (H_t):

$$H_{t+1} = f(H_t).$$

Such a model might yield a satisfactory harvest schedule for a short period of time, but it is not very useful if one wants to monitor the feasibility of the harvest schedule. This model would churn happily along whether or not there is sufficient inventory to meet the harvest.

At the other extreme from the simple model above one can conceptualize a general equilibrium model, such as implied by the RPA, which would allocate forestland among competing uses based on criteria of economic efficiency (presumably representative of human welfare). An analysis using this model would include present and future needs for

timber, as well as all other goods and services. The production functions for timber would compete with those of all other goods and services for limited supplies of the factors of production, e.g. land, labor and capital.

The issue in designing a model for supply analysis is choosing the functional relationships one wants to make explicit. What will be determined endogenously (inside the model) and what will be determined exogenously (outside the model)? Endogenous determination of variables or components implies optimization. Functional relationships describe the structure within which allocations or selections are made. The model then allocates or selects subject to objectives and constraints.

Determinations made exogenously are "givens". They may arise by guess, assumption or analysis. They could represent "optimizations" made within other subsystems, or merely estimates about the way things are likely to be.

It is tempting to discuss idealized models such as the general equilibrium model in the context of what timber supply analysis ought to include. To do so implies that these analyses would be improved by building complex models. However, it is not clear this is true. Although the model may limit the approach, the approach need not be limited to a model. An approach can include linking several models such that the output of one becomes the input of another. It can also include manipulating a model or models through successive runs to achieve solutions which meet objectives and constraints.

This analysis will address approaches, not models. Models become a limitation to the approach only when severe deadlines are imposed or when analysts wed themselves to a model. The context of this analysis presumes time will be available to consider new approaches and models, and that analysts will be receptive to them, and most probably directly involved in developing them.

Positive and Normative Approaches

It is common in discussions of supply analysis to distinguish between positive and normative approaches (see Heady, et al, 1961 and Mills, 1976). Briefly, a positive approach attempts to show things as they do, or are likely to, exist. Heady (1961) also refers to this approach as descriptive or predictive.

A normative approach is designed to show what ought to be, given certain conditions and assumptions.

Most timber supply analyses are a combination of these two approaches, tending to become more normative as the time horizon of the analysis lengthens. This occurs because timber management assumptions for the future tend to reflect the way foresters think stands ought to be managed, which in turn implies price relationships which ought to exist for such management to be justified, and all this ultimately dictates harvest trajectories which yield either maximum physical or economic returns, depending on what the analyst thinks we ought to maximize.

Short-term analysis is limited by existing inventories and tends to be constrained by current management practices, prices,

technology and institutional constraints. Thus, even though the analyst believes we ought to be able to grow 200 cubic feet per acre per year, he may be stuck with the fact that we're only growing 45 and no options for changing that in the short-term. Harvest options range from zero to all the inventory with the maximum likelihood harvest at time t + 1 being close to that at time t, the trend being strongly influenced by current inventories and established policy — i.e. "what is."

It is futile to try to classify approaches as strictly positive or normative. Nor is it very useful to try to classify the approach by how the analysis is presented. Often analysts are confused themselves. For example, a sloppy presentation of an analysis of biological potential may leave the impression it is a prediction of what will occur. A decidely normative analysis can be made to appear positive.

"If You Don't Know Where You're Going,
Any Road Will Get You There"

Presumably timber supply analyses are being done for someone who is trying to accomplish something. Clients might include scholars, planners, investors, technical timber analysts, other technical analysts, non-technical concerned citizens, politicians, combinations of these, and perhaps others. There may be a special focus for any of these clients. Some may be interested in a specific geographic region or timber species.

Others may be interested in the interface between timber and other things, e.g. the economy. Still others may be more concerned about how the analysis is done than they are about what it shows. A review of past timber analyses would show a significant range of effort to direct analyses at various audiences. The varied audience is both a curse and blessing. It is very frustrating for the timber supply analyst to choose among approaches; on the other hand almost anything that is done will please some group. Some would be satisfied with nothing more than a booklet of timber inventory statistics which might serve as input to a person's own analysis or furnish figures for a businessman's speech. At the extreme, there are some who would not be satisfied if the analysis didn't include projections reflecting all the interactions of the world economy.

The answer to the dilemma of how to do timber supply analyses does not lie in harping about right and wrong approaches, but in recognizing that there is room for all kinds of analyses. The key question is whether the approach is consistent with the stated objective. Given an objective, the arguments might more constructively focus on the efficiency of alternative approaches to achieve it. Or, perhaps, on a higher philosophical plane, the arguments might be about whether a particular objective is appropriate.

The Oregon Timber Resources Study (referred to hereafter as "the Oregon study") (Beuter, et al, 1976) provides an example to illustrate some of these points. That study followed closely on the heels of a Forest Service study (Gedney, et al, 1975) which showed likely harvest

trajectories for several states, including Oregon. Although the two studies used vastly different approaches, the trends shown for comparable geographic areas were quite similar. This caused some to ask why the second study was needed. It wasn't, for those who had no interest beyond generalized timber harvest trends for large geographic areas in the state. However, the Oregon study set out to, and did, answer other questions of specific interest to Oregonians. The analysis focused on subregions within the state and local economic impacts.

For both studies the approach was consistent with the objectives and, beyond the integrity of the data and assumptions, there doesn't appear to be much to argue about.

Another example relating to the Oregon study is the comment made by some that it is an incomplete timber supply study because it doesn't consider demand for timber. The charge is true, except for the implication that the Oregon study was intended to be a "supply" study. In fact (to the best of my knowledge) the word "supply" in the context of "supply study" never appears in the report. It was not intended to be a supply study, and it is not. It was intended to present a range of harvest trajectories which would be reasonable to expect based on current conditions, trends, expectations, and some possibilities of changes in public timber policy. The link to future economic conditions is implied by expectations reflected in management plans. The study does not address future demand for timber, prices, nor national or world economic conditions,

except insofar as expectations about these things are reflected in the timber management regimes anticipated by private forest owners.

Approaching the Approach

It is trite to say one should always start with the objective, but that remains the best place to start. Is the intent to do a supply analysis? A projection of biological potentials? Or, perhaps, the goal is to project trends in harvest, and at the same time provide a reference book of resource statistics. What geographic area should be covered? Who is the principal audience?

In planning the Oregon study, these considerations were relatively easy, but still required several months of planning and deliberation. The reason for doing the study was clear from the beginning: citizens had asked the Governor whether current harvest levels could be maintained indefinitely. The focus was on the economic well-being of local areas. The Governor wanted to know the answer to that question, as well as what options existed for mitigating any problems that might exist now or in the future.

The study team planned the approach (and ultimately the model used in the analysis) by asking over and over what kind of information is needed to answer the immediate question. What kind of information is needed to show the options that exist? What capability is needed to analyze options?

In retrospect, several key decisions made in planning the approach

were significant in keeping the study on track during public discussion, and later, when in the heat of doing the analysis, it was tempting to get sidetracked. They were:

1. Specific owner classes within local areas were to be the focus of the study. The study team defined timbersheds (economic areas characterized by a major timber processing center that obtains at least two-thirds of its timber from the timbershed in which it is) and intended to do individual analyses for each owner class in each timbershed.

2. It was assumed that demand for timber would continue strong for the next 30 years such that timber prices would increase at least as much as prices in general. This was an easy assumption to make because several current analyses projecting strong demand had not been disputed.

3. The study would focus on timber only, developing the best data base possible. All other forest uses and restrictions on timber growth would be distilled into the data and assumptions used.

4. The study team would not presume problems when viewing the study results, and thus would not attempt to make further analyses to see if "problems" could be solved. The study was viewed as the first stage of a broader analysis. The Oregon Board of Forestry had the job of using the study results to identify problems and identify options for solving them.

5. Following from the fourth decision, it was decided the approach would make all data and assumptions as explicit and visible

as possible. The model would anticipate analyses to be made later and have capability beyond the immediate needs of the study.

The first decision was critical to the usefulness of the analysis. It defined the relevant focus for Oregonians. Detailed local information was needed to identify problems and opportunities. Yet some reviewers of the study plan were critical of that approach for various reasons. Some believed the study shouldn't focus on timbersheds because if harvest declines showed up, public confidence in foresters, the industry, the public agencies, etc. would suffer. Others believed it was presumptious to calculate harvest levels for individual National Forests or other administrative units. Why not just accept their announced allowable cuts and let it go at that?

The second decision helped limit the scope of the analysis with regard to demand analysis. Achieving price stability for wood products was not an objective of the study so the team could retreat comfortably into the assumption that whatever timber Oregon produced could be sold at prices relatively the same or better (to Oregon timber growers) than prices at the time of the study. The Forest Service had conservatively estimated that timber consumption in the U.S. alone would rise 47 percent between 1973 and the year 2000 so our assumption seemed safe.

The third decision was a hard one in the face of leading-edge thinking (e.g. the RPA) that one shouldn't do single resource

analyses in forestry. With apologies, the study team referred to the concerns which were the impetus of the study (timber, jobs, economic well-being) and felt, for the purposes of the study, environmental concerns and trade-offs with other resources could be distilled into the data and assumptions. Thus, the land classification and prospective timber yields of the analysis reflected reasonable (at the time) allocations reflective of other forest objectives. The analysis would be, at least, a base against which to measure the future changes which were certain to occur.

The fourth decision is closely related to the discussion of positive and normative approaches. The study team intended a positive approach -- a description of what is and what is likely to be. Crossing the boundary into problem solving or policy analysis would be a move into normative analysis. ("If you want to solve this problem here's what you ought to do.") Not only would such a move have complicated the presentation of results, it probably would have decreased the value of the study. The single most-heard comment, about the study's value, across the entire spectrum of special interests in Oregon, is that it is objective and does not say or imply that any particular action ought to be taken. Some options are evident in the presentation; none are advocated.

The fifth decision insured the study's credibility. Assumptions, data and the analytical model were to be as detailed and open to view as possible. The focus for debate would be on the inputs and the process, not the results. If someone thought the harvest trajectories

were wrong, they would have to begin with an hypothesis of why they were wrong, which presumably would focus on data, assumptions or the model. The opportunity would exist to test the hypothesis, plugging in new data or assumptions, or testing the model with a known (previously tested) set of data and assumptions.

This discussion of the formulation of the approach for the Oregon study is intended to show the virtue of careful planning, sensitive to the purpose intended for the analysis. Some might argue that the discussion more likely reflects an attempt to dispose of things the study team either didn't want to or couldn't do. That is true to some extent -- preferably it would be called putting the sideboards around the analysis, or recognizing the constraints.

Constraints on the Approach

One may start out to do a timber supply analysis in the complete sense of the word "supply," or a complete analysis of policy alternatives, or a complete analysis of timber management alternatives. In most cases time will be the most binding constraint. One doesn't usually have time to do a complete job of building the appropriate model(s), gathering data, making all possible analyses and writing complete, concise reports. The RPA serves as a good example. The 1975 assessment was a crash project by the Forest Service of bringing together in one place what already existed, but was scattered about. The 1980 assessment and program

allowed time for development of some new techniques and the consolidation of some new data, but to a significant extent the 1980 timber supply analysis is constrained by the lack of time to develop new approaches. Hopefully, time will be available before the next major assessment (presumably 1990) to evaluate existing approaches and develop new ones as needed.

CONSIDERATIONS IN CHOOSING APPROACHES FOR NATIONAL TIMBER SUPPLY ANALYSIS

Considering approaches for national timber supply analysis is not easy. As mentioned before, one difficult aspect is the wide audience. Another is the broad charter provided by RPA which could embrace a multitude of approaches.

It is tempting to discuss supply analysis in the sense of its literal meaning to economists. Doing so would take for granted the biological aspects of timber projection and focus on achieving equilibria between national and regional supply and demand. To some extent this is being done in the 1980 assessment where an elaborate econometric model is being employed to forecast the derived demand for timber and allocate it to owner classes within regions of the country. The approach is a major breakthrough in national demand analysis, but has a weak link on the supply side. Supply analysis is limited to testing the feasibility of the allocated harvest levels. This approach may be useful for a national audience concerned with price stability of wood products, but it is not very satisfactory for local areas where supply originates. It doesn't account for options in land-use and timber management methods. It doesn't consider regional economic and social impact. In short, the approach is deterministic on the supply side in the sense that so much timber is available, so much timber will be grown and so much timber will be cut over time.

Deficiencies of past timber supply analyses have been covered

by several writers. Marty (1969) concluded: "The major current need in timber supply studies is to introduce the responses of both public and private growers to economic conditions and other factors as variables in the projection procedure." Seven years later Mills (1976) wrote of the need for an "operational timber supply projection technique which incorporates explicit analytical assumptions about biological, economic and management conditions." Vaux (1976) wrote of "a need for (a) methods of survey and multiple-use analysis adequate to determine local interactions among uses, and for (b) methods for aggregating the results of such localized studies into significant descriptions of regional and national situations."

What approach can be used to accommodate all these needs?

Key Considerations

A start can be made by separating the supply analysis into its major decision components:

1. Allocation of land to timber growing
2. Selection among timber growing alternatives
3. Selection among harvest policies (schedules)

Allocation of Land To Timber Growing

The determination of the timber growing land base is usually done exogenously. Land that is now growing timber or capable of growing timber, but not in another use usually comprises the base.

Customarily land allocated to timber is assumed to be used for timber growing forever, although in some analyses land is moved into and out of the base by assumptions about changes in land use.

Vaux's suggestion implies, as does the RPA, that land-use decisions be made endogenous to the supply analysis. This will require consideration of the production functions for competing and joint land uses, and presumes the ability to relate supply possibilities to the demand for the "relevant outputs from the land." (Vaux, 1976)

Vaux (1973) presented a technique for estimating the "long-run timber supply function for California" based on yields and costs of production for various type-sites. When matched with a long-run demand curve the limits of economic feasibility for timber management were identified. Presumably such a technique could be used to allocate land to timber production, however it remains to be seen if it will become practical. As Vaux points out much land (and perhaps more importantly for the short-run, much inventory) on public lands is classed as commercial forest land even though it is economically submarginal for growing timber. Serious policy questions would be involved in changing that situation.

However it is determined, the land base is the foundation for timber supply analysis. It defines the limits of currently usable inventory and the capability to produce timber over time. The inventory can be viewed as a "given", but the capability to produce timber is a variable, depending on how the timberland is to be managed.

Selection Among Timber Growing Alternatives

Marty (1969) pointed out that the combinations of productivity classes and management regimes can be many, even for a relatively small area. However, detailed breakdowns may be necessary to identify significantly different economic opportunities. Not only is such information vital to the allocation of land to timber production as discussed above, it is necessary for developing economically feasible growth and harvest projections. The issue of whether the test of economic feasibility should be endogenous or exogenous to the analysis parallels that for land allocation. In fact the two issues are inextricably linked since the timber management regime determines the long-run costs of production when timber is the only land-use alternative being considered.

As with land allocation, timber growing alternatives are usually selected exogenously and are relatively fixed in the supply projection procedure. Mills (1976) points out that the Forest Service "Timber Outlook Study" (U.S. Forest Service, 1973) attempted to determine "financially acceptable" timber investments, however, "the management level assumption was buried in the TRAS projections and there was no way of knowing if the treatment opportunities evaluated were already included in the projection or not. In spite of these ambiguities, increased harvest attributed to management intensification was simply added to the harvest projection under 'current management'." Apparently the same procedure is being used

for the 1980 assessment.[2/]

Marty (1969) and Mills (1976) both propose the concept of homogeneous timber supply response cells which would be used to develop a supply function for timber. The concept is similar to that proposed by Vaux, except Vaux dealt only with long-run supply (the long-run sustainable harvest level), independent of current inventories and harvest policies and actions. Vaux's focus was on whether successive rotations of timber growing were economically feasible. The proposals of Marty and Mills have a more pragmatic orientation which includes the intentions of timberland owners, whether or not these are economically rational. The distinction here is between a normative and positive approach — more will be said about that later.

The issue of selecting timber growing alternatives can be summed up by keeping in mind that the result of the selection defines the long-run sustainable harvest level (LRSY). Given a land base, $\bar{B}$, LRSY is determined by the inherent productivity of the land, P, and the management regime, M:

$$LRSY = f(P, M|\bar{B})$$

where $P = \{p_1, p_2, \ldots, p_m\}$

$M = \{m_1, m_2, \ldots, m_k\}$

[2/] Based on a discussion about growth in the 1980 analysis the author had with Forest Service analysts in Portland, June, 1978. It was stated that management intensification is not accounted for in the TRAS growth rates.

The p_i contained in P represent type-site options over $\bar{B}$. The m_j contained in M represent the management options one might imagine over all p_i. An objective relevant to supply analysis may be to select the maximum LRSY from among all possible subsets:

$$\text{MAX} \sum_{i,j} \{p_i, m_j\},$$

subject to the policies and/or expected actions with regard to the m_j, and such that the sum of the acres equals the total acres in $\bar{B}$. The selected LRSY (hereafter referred to as $LRSY_R$) would be less than or equal to the biological maximum LRSY, greater than or equal to the wild (unmanaged) forest LRSY (Figure 1). The selected p_i represent the basic resource units for timber projection. The m_j associated with each p_i represent a collection of management activities to be practiced on the acres represented by p_i.

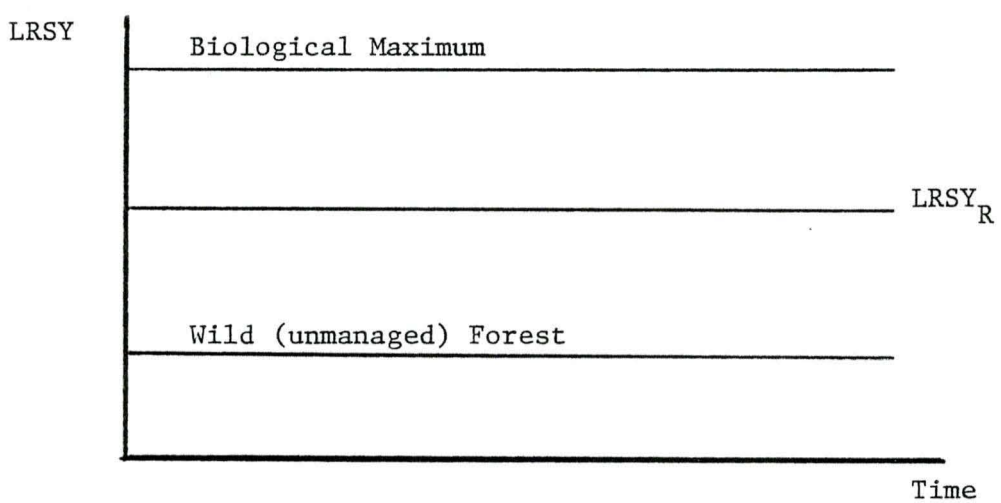


Figure 1. Perspective on LRSY options

$LRSY_R$ is not a measure of timber availability. It is a measure of potential harvest (hopefully, realizable potential). It is not necessarily a starting place; it is a target. It need not be fixed. Presumably a model could be constructed to rearrange the $\{p_i, m_j\}$ over time thus making $LRSY_R$ a variable. For example, one can conceptualize a price projection function perceived by a forest owner such that at time t, the owner may decide to put more or less timberland into production; and/or change management regimes on existing resource units.

For the purpose of discussion it is easiest to consider only a single $LRSY_R$ and use it as a reference for harvest scheduling.

Selection Among Harvest Policies (Schedules)

Selecting the basic resource units and associated management regimes determines $LRSY_R$. The supply analysis culminates with the development of harvest schedules. The harvest possibilities relative to $LRSY_R$ are determined by the present land base and inventory, the present management practices, assumptions about how the transition will be made from the present conditions to those represented by LRSY (includes land shifts, management intensity shifts, specific management practices and results), and the policies that guide (or limit) harvest over time. Conceivably, the process can be linked to general economic conditions by functional relationships (e.g. demand functions), or explicit or implicit assumptions. Some possibilities for secular changes are shown in Figure 2. If the land is bare, the transition involves an eventual increase to $LRSY_R$. (Curve A, Figure 2).

If the land has merchantable timber, there are many possibilities. It is possible the stocking is such that harvest might approach or vary about $LRSY_R$ (Curve B, Figure 2). Very light stocking, or a predominance of younger age classes might result in a harvest schedule similar to curve A. Or, an old-growth forest, with current growth far below $LRSY_R$, would have an eventual decrease in harvest over the transition, unless current harvest is constrained in some manner (Curve C, Figure 2).

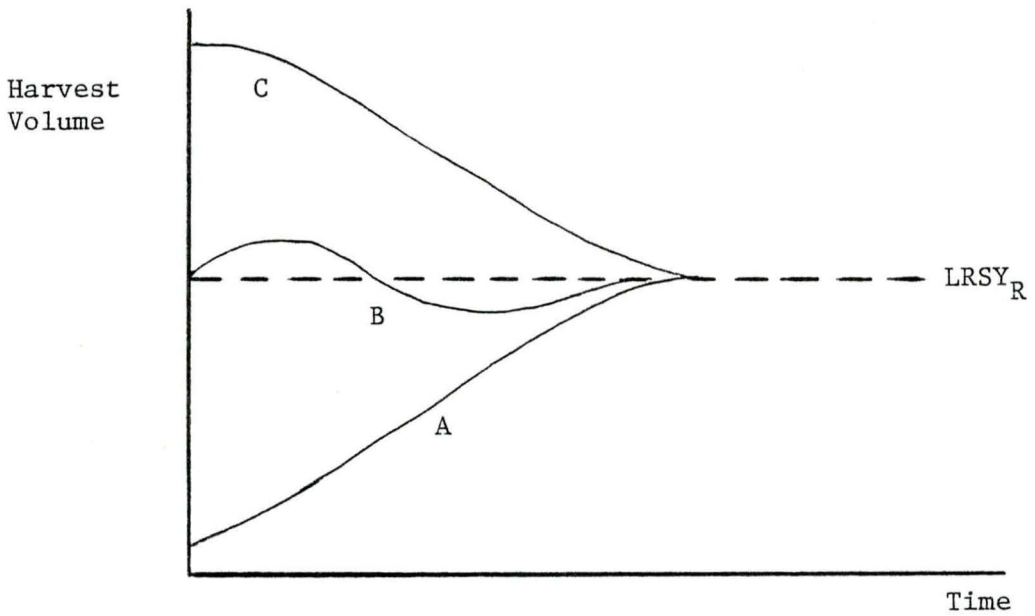


Figure 2. Alternative transition harvest trajectories

The output of a timber supply analysis is one or more harvest schedules. How these schedules are arrived at and how they are interpreted is crucial to the usefulness of the analysis. Harvest schedule policies incorporated into the analysis can vary widely, ranging from scheduling a harvest trajectory exogenously and testing its feasibility, to determining harvest endogenously, subject to specified conditions. The approach can be normative (how much ought be harvested) or positive (how much will be harvested). Or, it can reflect a mixture between positive and normative. For example, an owner can specify a criterion to be used to test the harvest schedule feasibility, such as harvest should equal growth in 100 years. That is an observation of the owner's management plan — what he intends to do. Incorporating that as a constraint and choosing an objective, such as profit maximization, the approach becomes normative in finding a solution of what the owner ought to do to maximize profit, subject to the constraint.

The past few years have seen some major developments in harvest scheduling techniques. Timber RAM, MAXMILLION, SIMAC, the TREES model developed by Oregon State, and new models under development by K. Norman Johnson for the Forest Service are examples. All these models have the capability of scheduling harvests in conjunction with specified objectives and constraints. All can consider long time horizons (multi-rotation). Among them, TREES may be the most useful for national or regional supply analysis because it can keep separate and monitor a large number of resource units, has an

elaborate control structure which permits varying and monitoring management assumptions and other aspects of a projection, can be used either for yield table (age-class based) or stand table (diameter-class based) projections, and it can employ a wide variety of harvest policies, including using economic criteria for scheduling harvests. The author is most intimately familar with TREES having used it for the Oregon Study, however no further elaboration of the model will be given here. Complete documentation of it will be published by Oregon State University by late 1978 or early 1979.

The point of mentioning these models is that previous national supply analyses have had limited opportunity to study harvest scheduling options because of model limitations. For example, TRAS severely limits options for analysis because the model cannot generate harvest schedules -- it merely tests the feasibility of ones generated exogenously. Aggregation or disaggregation of resource units is not possible within the model so it is very unwieldy to consider some harvest policy options. More disadvantages could be cited, but it is not the point to denigrate TRAS. It has been useful in its time, but options to it now exist and ought to be looked at. This presumes that it is desirable for future supply analyses to consider more options and to have more assumptions made explicitly and visible to users of the analysis.

Back to Approaches

Much of the criticism of national timber supply assessments stems not so much from what was done as it does from: a) what was not done and, b) the difficulty serious analysts have getting at the underlying assumptions and raw data which went into the analyses (this is discussed at some length by Mills, 1976). It is unreasonable to expect the Forest Service to do everything, so the first criticism will always be with us. However, one way to appease critics is to let them do their own analyses. One has to have a lot of time, support and perserverance to do so under the best of conditions, but the task is made considerably harder because national supply assessments in the past have been poorly documented. Questions about assumptions and data are often evaded, and perhaps unanswerable. Part of the problem is that the underlying work is done at regional levels and details become obscure as information is passed up for the aggregated analysis. Related to this, a significant portion of the harvest capacity of the nation is not subject to independent analysis in the national assessments -- that of the National Forests. Allowable cuts from National Forests have been accepted as is -- no options are considered, and, apparently no tests are made of the consistency of the underlying assumptions used to calculate the allowable cuts.

Despite such problems, past national assessments have been useful for many things. They have provided the authoritative source of national timber trends and are quoted widely in speeches

and in print. Often overlooked by critics of the national assessments are the follow-up studies usually done at regional levels which, by design or not, tend to supplement the national assessment. Many of these studies have provided useful information on management options, and regional economic and social impacts related to timber supply.

The problem may be one of design. The national studies are highly visible occurring on a more or less regular schedule. The regional studies tend to be sporadic, appearing in response to an issue, or at the whim of an analyst. Very few people have the background or awareness to tie together all the various studies. In fact, some consultants make a good living doing just that!

As approaches for future assessments are being considered, serious thought should be given to coordinating national and regional plans before the fact. This is especially desirable for timber-dependent regions such as the Pacific Northwest. In fact, it would seem desirable to include qualified local non-Forest Service people in the planning.

At this time the emphasis of national timber assessments seems to be on national wood products demand and price -- a reflection of national policy on price stability. There is no question that emphasis is important for guiding national legislation and administrative policy on everything ranging from National Forest management to programs for small woodland owners. However, regional concerns are important also. Timber supply is a

local issue, often affecting local economic well-being. It is not enough to say there is so much timberland capable of producing so much timber and, to achieve national goals, so much timber ought to be produced. The question of how much timber will be produced seems more relevant for a basic analysis to guide legislation, policy and economic decisions.

Oregon again provides a good case in point. To date, relatively little timber has been grown from scratch in Oregon. We have been cutting mostly timber that was found here. The situation is changing. A larger proportion of future harvests (virtually all harvests from private land) will be coming from timber we have grown or will grow from scratch. How much timber will be grown depends on the perception of land owners and investors of what it is worth to grow timber. Timber-growing is a business and like any business has to compete for capital.

At present, about 20 percent of the nation's softwood timber harvest comes from Oregon. About five percent of the nation's "commercial forest land" is in Oregon (U.S. Forest Service, 1973). Over 55 percent of the commercial forest land in Oregon is federally owned.

How has Oregon been analyzed in past national timber supply assessments?

State statistics have been presented commensurate with all other states, except that eastern and western Oregon are presented separately. That gives a bit more information than we get about

Illinois, but not much. Allowable cuts on National Forests are accepted as is -- no options are considered. Trends in private harvest are projected forward as long as feasible without consideration beyond very broad (obscure) assumptions about what private owners will or are likely to do. Some discussion of management intensification opportunities has been presented for the Douglas-fir Region and the Ponderosa Pine Region, but again the analysis very general and is not sensitive about what is likely to be done.

To do a national timber supply assessment without extra sensitivity about a major supplier such as Oregon is like doing a national automobile supply assessment without any special concern for what's happening at General Motors. If the national timber supply assessment is to be useful for policy analysis relative to Oregon's role as a national supplier, items such as the following seem essential to a thorough analysis.

1. What determines investment levels in timber growing in Oregon? What are private landowners likely to do?
2. What is the relationship of National forest harvest policy to economic stability in Oregon? What influence does it have on private owner attitudes toward investing in timber growing?
3. What is the <u>real</u> future role of Oregon as a supplier of the nation's timber likely to be?

The last point is a very important one. If one takes a Vauxian approach to identifying long-term supply functions, a very

high proportion of the commercial forest land in Oregon will rank among the highest rates of returns for timber growing, relative to the rest of the nation. Couple that with a higher likelihood that timber will be grown on that land in Oregon (mainly because of a lack of better investment opportunities), and it may be found that Oregon's percentage of the real commercial forestland base of the nation is closer to 20 percent than five percent. Linking that to the fact the federal government is the largest single owner of the timberland in Oregon, it is conceivable that federal policy will have a major impact on total (both federal and non-federal) timber supply from Oregon, and hence a major portion of the nation's supply. The implications go far beyond small woodland incentive programs. In fact, major federal land-use decisions are being made today without a truly sensitive perspective of future timber supply alternatives for the nation and the influence present actions will have on their feasibility. It would seem it is the role of the national assessments to provide this. In fact, it is mandated under the RPA.

Oregon is only an example for this discussion, which pertains also to other major timber supplying areas. The points raised help to illustrate and reinforce some of the needs discussed earlier and hopefully will contribute toward developing better approaches for national timber supply assessments. Some research (or perhaps, development) suggestions are evident.

RESEARCH NEEDS AND PRIORITIES

The term "research" will be used loosely in this discussion. Some items may be better termed development, organizational or administrative needs. They are listed in order or priority.

1. Planning the National Timber Supply Assessment

Consideration should be given to analyzing real supply potential, in contrast to the somewhat theoretical supply potential of past assessments. This means delineating supply areas by the biological, economic and institutional factors that determine whether land will actually be used for timber growing and if so, how it will be managed. Timber growing capability should not be confused with current inventory in evaluating future supply potential. For example, much land in the Rocky Mountains and elsewhere is carried as commercial forest land because it now has trees on it. However, the cost of growing new trees on the land may put it on the very inelastic portion of a national supply curve (it would take extremely large price increases to induce relatively low-yielding timber growing investments). At present such land is carried as if it will be harvested and successfully regenerated ad infinitum, regardless of the costs of production. The current inventory on such lands may be a relevant portion of supply potential, providing some degree of "timber mining" is acceptable. If so, the

lands should not be excluded from harvest scheduling alternatives. They could contribute significantly to short-term supply and pass out of the picture in the long-run. The same goes for lands likely to be urbanized or moved to other uses.

Consideration should be given to developing a hierarchy of supply nodes. Biological resource units (type-site units) serve as the foundation. These could then be aggregated into what Mills (1976) calls homogeneous supply response calls. This is where it gets tricky. The aggregation depends on what objective is sought, that is, what "supply response" is to be evaluated. At one extreme only biological potential may be of interest so the aggregation would be based only on biological criteria. At the other extreme, economic availability vis-a-vis competing land uses may be of interest so the aggregation would be made based on complex economic criteria. The goal is to find units for which common assumptions can be made about what will be done on the land and what the responses will be. These units might correspond to an owner, an owner class, a group of owner classes or a geographic area. Or, they could be based on species-types, location, geographic feature or whatever else might be deemed important. However, determined or designated they form the analytical building blocks for supply analysis.

The next higher nodes depend on what level was chosen for the basic building blocks. It would be likely that owner classes would be of interest or some other distinctively meaningful administrative unit. These would be aggregated into policy nodes --

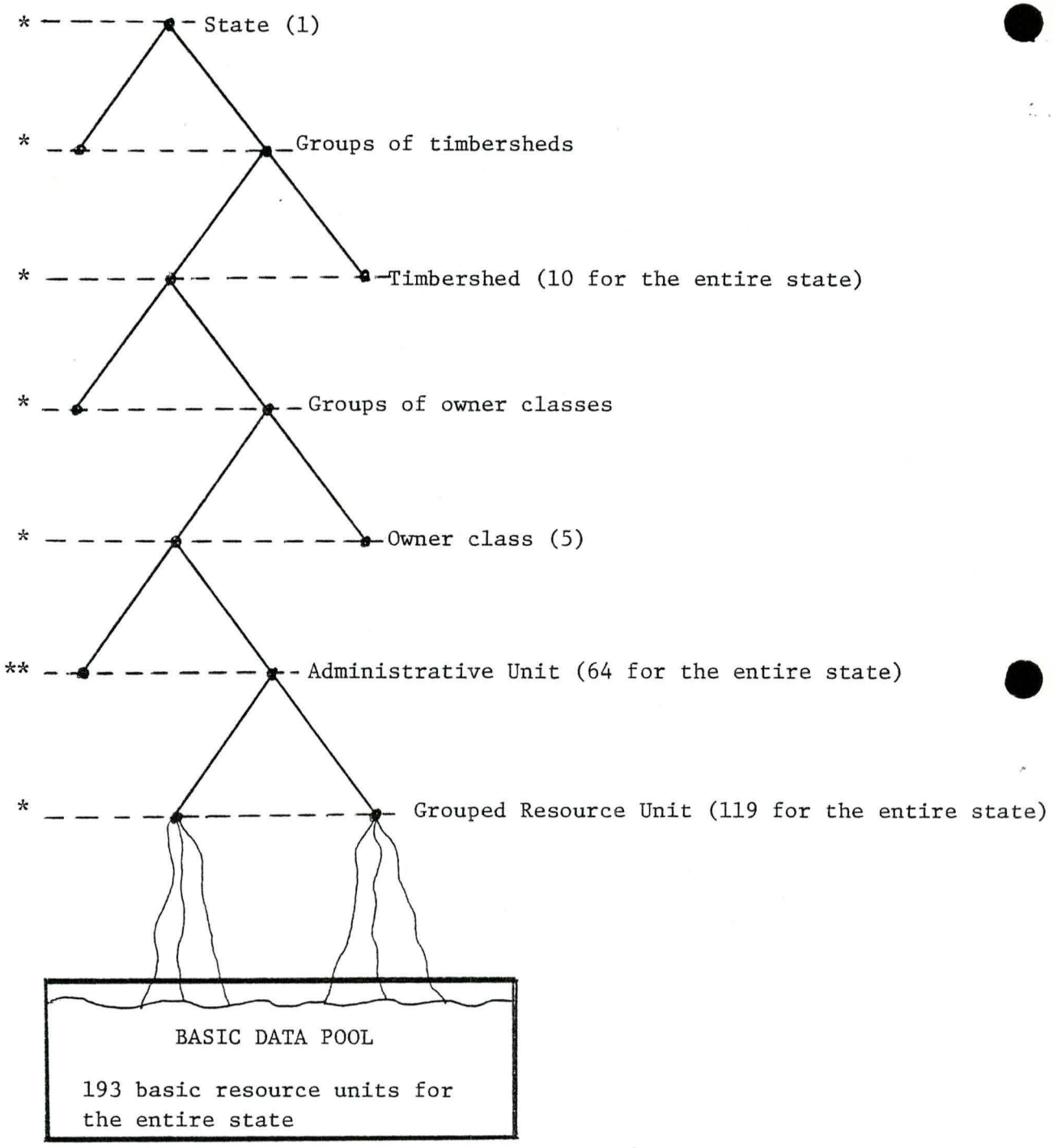
the point where laws, policies and regulations are evaluated. Next might be the supply region (the contiguous timber market area deemed uniquely important for analysis) and so forth.

Figure 3 shows the hierarchy adopted for the Oregon study (Beuter, et. al. 1976).

As mentioned earlier, a key supply node for the Oregon study was the timbershed. Timbersheds were selected to deal with the basic question of the analysis -- what is happening at local levels. National assessments can similarly be planned with sensitivity to important concerns. Exactly how it should be done will require much study and careful planning.

2. Coordination With Regional Cooperators

Planning the structure for the supply analysis requires careful coordination with the various regions. Analysts in the regions, non-Forest Service as well as Forest Service, are the sources for the local area sensitivity needed, for planning of the analysis, and subsequently gathering the data needed to execute it.


* State (1)
* Groups of timbersheds
* Timbershed (10 for the entire state)
* Groups of owner classes
* Owner class (5)
** Administrative Unit (64 for the entire state)
* Grouped Resource Unit (119 for the entire state)
BASIC DATA POOL
193 basic resource units for the entire state

*Levels at which harvest scheduling can occur

**Level at which harvest scheduling was done in the Oregon study

Figure 3. Hierarchy of supply nodes used for the Oregon study

Local Area Sensitivity

Each region of the country has a different relationship to its forests. The role a region's forests will play in national timber supply depends to a large extent on the attitudes and actions of the local people. For example, some of the so-called "other private" land in the South is being managed intensively by the forest industry under lease arrangements, or by consultants. Yet it is not clear whether this has been accounted for in past assessments. It should be. Some means should be developed to obtain realistic "timber supply curves" for the relevant levels of the analysis. The "timber supply curves" referred to here could be the price-related ones of Vaux, or based on whatever criteria are deemed to influence whether, and how much, timber is going to be grown and cut.

Whether timber will be cut is an issue separate from growth in some cases. Present analyses take it for granted timber will be grown on commercial forest land, albeit perhaps at a low intensity. It is also taken for granted that it will be cut when needed to satisfy national demand. That may or may not be true. An objective would be to isolate the land for which that is likely to be true and qualify the analysis for the remaining lands. This cannot be done without sensitive local input.

Another local concern is forest policy. How is forest policy formulated at the regional level? What policy issues should be visible in a national supply assessment? What kind of information is needed to evaluate supply-oriented policy? Input from local

political bodies, local industry, local environmental and citizen groups may be useful in deciding on the relevant structure for analysis.

Data Needs

The Forest Survey of the U.S. Forest Service has provided the bulk of the forest inventory data for national assessments. Supplementary data from the National Forests and others has also been used. There may be more opportunities to coordinate Forest Survey with local needs to strengthen the data base for important supply regions. Current inventory is important for the short-term, but for the longer term it is very important to have reliable information about timber producing capability and the likely levels of output. For example, for the Oregon study, forest industry landowners were interviewed about their short-term and long-term management plans on a tract-by-tract basis. This was somewhat crude because it distilled all of their expectations about the future. A more elaborate approach would involve trying to find variables that would influence future changes in management direction. However, what was done was very useful for establishing a base for policy analysis.

The industry owners were also interviewed about the present management level of these tracts. Existing forest inventory data may tell us what is on the site, but it is not very useful to tell us how it is being managed. Does a low stocking per acre indicate a poorly regenerated stand, one that has been thinned, or perhaps one that has been damaged by animals or other natural interlopers? It is possible to rate such a stand at a low level of management

when in fact it could reflect a very high level management in terms of investments made to overcome problems.

The types of data which might be needed to supplement the data base customarily used are:

1. Supplementary plot information for classifying a site biologically and economically.
2. Information about management plans by forest owners; research on what induces owners to change management direction. What criteria are used to decide to grow and cut timber?
3. Data needed to make assumptions for the projection, e.g. utilization trends; trends in regeneration practices; trends in silvicultural practices; trends in harvesting practices; land-use shifts; management practice shifts; ownership shifts are a few. Also needed are yield tables, growth rates, costs, prices, and so forth.

The control structure of the TREES model used in the Oregon study requires many explicit assumptions. It would serve as a good reference for deciding what data might be needed.

Much emphasis has been placed on uniformity across the nation in designing the Forest Survey. No doubt uniformity provides some benefits by simplifying control, understanding and, perhaps, usability of the data. However, it may incur significant costs in that it forces averaging that can result in too much data being generated in areas of low significance to national timber supply and too little in areas of high significance.

Coordinating data needs for new approaches to the assessment will be a significant challenge. It has to be done with sensitivity to local needs and in the context of the structure chosen for the supply analysis. Data, like a model, can limit the approach. Data and the model can limit one another so it is hard to say whether data should be considered before models, vice versa, or whether they should be considered simultaneously. It depends on the time and dollar constraints for the planning phase.

3. Choosing the Means of Doing the Analysis (Considering Models)

As mentioned earlier, models for harvest scheduling are proliferating; each having its own advantage and disadvantages. The options for future assessment range from continuing to use TRAS, to choosing one or more existing models, to building a whole new analytical capability. Specific models won't be discussed here because it doesn't seem relevant to discuss models until an approach for future assessments has been designed. During the design stage conscious decisions will have to be made about constraints that may limit the choice of models and the type of data that will be collected.

Choosing models will have to be done in the context of the approach desired -- whether the emphasis will be on normative analysis (implies optimizing capability) or a positive analysis (implies simulating capability). Should land be allocated outside the model (land allocation

is an input) or inside the model (land allocation is an output)? Should acres to be thinned be an input or an output? How will the model be linked to demand, i.e., how will the relationship between supply and demand be handled?

These and many other questions need be addressed.

4. Designing Documentation and Feedback Opportunity

Past timber supply assessments offered little opportunity to consider alternatives after publication, except by trying to influence how the next assessment was to be done ten years or so hence. Consideration should be given to developing ways to make the raw data and assumptions easily available to others for the purposes of evaluating the assessment, and to provide opportunities for further analysis. It can be argued that such information always has been available. But my personal experience and comments by others indicate it is very difficult to pin down assumptions, techniques and some data after the assessment is published.

Related to this is the suggestion earlier that national and regional studies be better coordinated before the fact, a national assessment may spawn several studies by regional Forest Service analysts. That these studies will be done should be made known as part of the overall plan. Then, additional studies can be planned around those. For example, if there is regional interest in a study

not included in the national or regional plans of the assessment, analysts outside the Forest Service may choose to undertake the study. Since such studies often require Forest Service data, and perhaps even the analytical models used by the Forest Service, the assessment plan should include the means to make such information available efficiently.

A PROPOSAL

At this point I feel about in the same position Will Rogers was when he suggested the U.S. deal with German U-boats during World War I by boiling the Atlantic Ocean and picking the U-boats off as they surfaced. When asked by a reporter how he proposed to boil the Atlantic, Rogers replied: "I just come up with the suggestions. It's up to the government to figure out how to carry them out."

This paper contains many suggestions, some of which may appear as infeasible as boiling the Atlantic Ocean. I purposely avoided suggesting specific studies because doing so would presume I know the best approach for future assessments. Some of my ideas of what ought to be considered are presented here, but I believe the top priority is to stand back and do some visionary planning before conclusions are made about what data should be gathered or models should be built.

The choices for the next supply assessment range from small adjustments to the existing approach, to designing a whole new approach. If a new approach is desired it is imperative that time and resources be allocated to discussing, planning and designing it. An explicit timetable for accomplishment should be set. The Forest Service must take the leadership in this since they have the responsibility for the national assessments.

It would be desirable for the Forest Service to seek ideas to initiate the planning process. This could be done with a workshop

comprised of a limited number of people with experience in conceptualizing and/or actually planning timber supply (availability) studies. The focus of the workshop should be alternative approaches for national supply assessment in the context of whatever constraints exist. Discussion of what model to use or what data to collect should be expressly prohibited, except as needed to make points related to overall objectives and constraints for a national supply assessment. Models and data may be the subjects of later workshops.

This is not a proposal to duplicate the IUFRO workshop "Forecasting in Forestry and Timber Economy" (IUFRO, 1971). The results of that workshop and other related work could certainly provide useful background, but the workshop I am proposing should deal with the specific challenge of how a timber supply assessment for the U.S. should be done, subject to real constraints. One important function of the workshop would be to ferret out whether some constraints are real or merely perceived. For example, the Forest Service may have had policies which limited what could be done in past assessments. These may be perceived constraints to analysts within the organization. An open discussion may show these constraints to be negotiable.

At worst, the workshop would bring together some ideas. Hopefully, it would accomplish much more toward outlining an optimal, feasible approach. Once that is done, further workshops on models and data would seem advisable.

It would be desirable to maintain continuity of thinking

between planning the approach, planning how it will be executed and doing the work. A small advisory group (three to five well-qualified people representative of the objective thinkers and doers in timber supply analysis)[3/] should be considered to provide continuity. Both Forest Service and non-Forest Service people should be considered. This group should be dedicated to being intimately involved in each step of the process and should be prepared to share the responsibility for failures as well as the praise for successes.

The charter contained in the RPA and the breathing time between the 1980 assessment and the next one provide the impetus and time needed. It seems reasonable to expect that the next timber supply assessment will be much improved over the ones present and past.

[3/] Opinions of inflexible advocates, dilettantes and the general public should certainly be sought, but in some other manner. Care should be taken not to dilute the intensity and commitment of an advisory group by mixing a wide range of qualifications and motives.

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